Extra Example 3

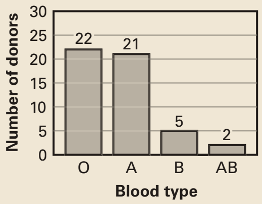
A standard six-sided die is rolled. Find (a) the odds in favor of rolling a 6 and (b) the odds against rolling an odd number. **1 : 6; 1 : 1**

Key Question to Ask for Example 3

- If the odds against an event are a : b, what are the odds in favor of the event? **b : a**

Extra Example 4

The blood types for a sample of donors at a blood drive are displayed in the bar graph. Find the experimental probability that a randomly selected blood donor would have blood type O?



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Mathematical Reasoning

Multiple Representations The odds for and against an event can also be expressed as ratios of probabilities. Odds against an event is $\frac{\text{P (event fails to occur)}}{\text{P (event occurs)}}$. Odds for an event is $\frac{\text{P (event occurs)}}{\text{P (event fails to occur)}}$.

EXAMPLE 3 Find odds

AVOID ERRORS
Note that the odds in favor of drawing a 10, which are $\frac{1}{12}$, do not equal the probability of drawing a 10, which is $\frac{4}{52} = \frac{1}{13}$.

A card is drawn from a standard deck of 52 cards. Find (a) the odds in *favor* of drawing a 10 and (b) the odds *against* drawing a club.

Solution

a. Odds in favor of drawing a 10 $= \frac{\text{Number of tens}}{\text{Number of non-tens}} = \frac{4}{48} = \frac{1}{12}$, or 1 : 12

b. Odds against drawing a club $= \frac{\text{Number of non-clubs}}{\text{Number of clubs}} = \frac{39}{13} = \frac{3}{1}$, or 3 : 1

EXPERIMENTAL PROBABILITY Sometimes it is not possible or convenient to find the theoretical probability of an event. In such cases, you may be able to calculate an *experimental probability* by performing an experiment, conducting a survey, or looking at the history of the event.

KEY CONCEPT *For Your Notebook*

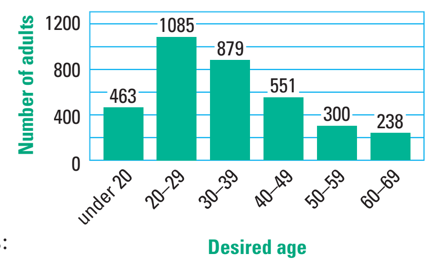
Experimental Probability of an Event

When an experiment is performed that consists of a certain number of trials, the **experimental probability** of an event A is given by:

$$P(A) = \frac{\text{Number of trials where } A \text{ occurs}}{\text{Total number of trials}}$$

EXAMPLE 4 Find an experimental probability

SURVEY The bar graph shows how old adults in a survey would choose to be if they could choose any age. Find the experimental probability that a randomly selected adult would prefer to be at least 40 years old.



Solution

The total number of people surveyed is:

$$463 + 1085 + 879 + 551 + 300 + 238 = 3516$$

Of those surveyed, $551 + 300 + 238 = 1089$ would prefer to be at least 40.

$$P(\text{at least 40 years old}) = \frac{1089}{3516} \approx 0.310$$

✓ GUIDED PRACTICE for Examples 3 and 4

A card is randomly drawn from a standard deck. Find the indicated odds.

4. In favor of drawing a heart $\frac{1}{3}$

5. Against drawing a queen $\frac{12}{1}$

6. **WHAT IF?** In Example 4, what is the experimental probability that an adult would prefer to be **(a)** at most 39 years old and **(b)** at least 30 years old?

6a. about 0.69
6b. about 0.56

Differentiated Instruction

Advanced The odds in favor of an event can also be expressed as $\frac{\text{P (the event occurs)}}{\text{P (the event does not occur)}}$. Challenge students to express **Example 3a** in terms of this definition. Then ask them to show how they can use a formula that involves combinations and probabilities to model this situation. Doing so will help them relate combinations, probability, and odds.

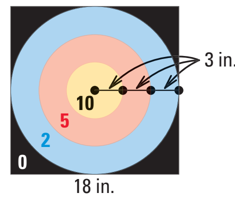
See also the Algebra 2 Toolkit for more strategies.

2. Theoretical probability is the probability if all outcomes are equally likely to occur, while experimental probability is the probability of an experiment of a certain number of trials. Sample answer: Assume a spinner has 6 different colors. An example of theoretical probability is what is the probability of spinning one of the colors. An example of experimental probability would be to spin the spinner 10 times and then determine the probability for a color.

GEOMETRIC PROBABILITY Some probabilities are found by calculating a ratio of two lengths, areas, or volumes. Such probabilities are **geometric probabilities**.

EXAMPLE 5 Find a geometric probability

DARTS You throw a dart at the square board shown. Your dart is equally likely to hit any point inside the board. Are you more likely to get 10 points or 0 points?



Solution

$$P(10\text{ points}) = \frac{\text{Area of smallest circle}}{\text{Area of entire board}}$$

$$= \frac{\pi \cdot 3^2}{18^2} = \frac{9\pi}{324} = \frac{\pi}{36} \approx 0.0873$$

$$P(0\text{ points}) = \frac{\text{Area outside largest circle}}{\text{Area of entire board}}$$

$$= \frac{18^2 - (\pi \cdot 9^2)}{18^2} = \frac{324 - 81\pi}{324} = \frac{4 - \pi}{4} \approx 0.215$$

▶ Because $0.215 > 0.0873$, you are more likely to get 0 points.

Animated Algebra at classzone.com

✓ GUIDED PRACTICE for Example 5

7. **WHAT IF?** In Example 5, are you more likely to get 5 points or 0 points? **5 points**

10.3 EXERCISES

HOMEWORK KEY

○ = **WORKED-OUT SOLUTIONS** on p. WS1 for Exs. 7, 17, and 39

★ = **STANDARDIZED TEST PRACTICE** Exs. 2, 19, 26, 27, 32, and 42

◆ = **MULTIPLE REPRESENTATIONS** Ex. 40

SKILL PRACTICE

A

1. **VOCABULARY** Copy and complete: A probability that is the ratio of two lengths, areas, or volumes is called a(n) __?__ probability. **geometric**

2. ★ **WRITING** *Explain* the difference between theoretical probability and experimental probability. Give an example of each. **See margin.**

EXAMPLE 1 on p. 698 for Exs. 3–16

CHOOSING NUMBERS **You have an equally likely chance of choosing any integer from 1 through 50. Find the probability of the given event.**

3. An even number is chosen. $\frac{1}{2}$
4. A number less than 35 is chosen. $\frac{17}{25}$
5. A perfect square is chosen. $\frac{7}{50}$
6. A prime number is chosen. $\frac{3}{10}$
7. A factor of 150 is chosen. $\frac{1}{5}$
8. A multiple of 4 is chosen. $\frac{6}{25}$
9. A two-digit number is chosen. $\frac{41}{50}$
10. A perfect cube is chosen. $\frac{3}{50}$

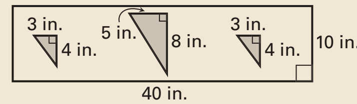
Differentiated Instruction

Inclusion Some students may need help organizing their thinking. Certain scenarios may be more difficult to interpret than others, making it hard to determine which formula to use. Have students rewrite **Example 5** in their own words. Then have them describe what the goal of the problem is, what formula they should use, and discuss the significance of the solution.

See also the Algebra 2 Toolkit for more strategies.

Extra Example 5

Find the probability that a dart thrown at the rectangular board hits one of the triangles.



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Key Question to Ask for Example 5

- In part (b), how do you determine the area of the black region? **Subtract the area of the largest circle from the square.**

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An **Animated Algebra** activity is available on-line for **Example 5**. This activity is also available on the **Power Presentations CD-ROM**.

Closing the Lesson

Have students summarize the major points of the lesson and answer the Essential Question: How do you find the probability that when 5 cards are drawn from a deck, 4 of them will be aces?

- **When all outcomes are equally likely, the theoretical probability than an event A will occur is:** $P(A) = \frac{\text{Number of outcomes in event A}}{\text{Total number of outcomes}}$.
- **The experimental probability of an event A is the ratio of the number of trials where A occurs to the total number of trials.**
- **When all outcomes are equally likely, the odds in favor of an event A is the ratio of the number of outcomes in A to the number of outcomes not in A. The odds against A is the ratio of the number of outcomes not in A to the number of outcomes in A.**
- **Geometric probability is computed as the ratio of two lengths, areas, or volumes.**

Use the formula $P(4\text{ aces}) = \frac{{}_4C_4 \cdot 48}{{}_{52}C_5}$.